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THE LOSS OF LIGHT BY ABSORPTION AND REFLECTION IN THE 36-INCH OBJECTIVE.

By J. H. Moore.

The visual objective of the 36-inch refractor of the Lick Observatory consists of two lenses, a brief description of which, as furnished by Alvan Clark & Sons, is as follows:—

	Radii of Curvature.[*]		Thickness.	
			Center.	Edge.
	Inches.	Inches.	Inches.	Inches.
Crown No. 1734	$R_1 = +259.52$	$R_2 = +259.52$	1.96	0.60
Flint No. 1588..	$R_3 = -239.59$	$R_4 = -40000.$	0.93	1.65

It will be seen that the total thickness of glass is about three inches. Now, from the table given by Professor Vogel,[†] for the loss of light in lenses of different thickness, we find that the loss for the visual rays in the 36-inch objective is about twenty-seven per cent and for the photographic rays forty per cent.

In spectrographic work a thin double-concave lens (2.5 inches aperture) is placed one meter within the visual focus to correct for chromatic aberration in the region λ 4500. The loss at this lens is estimated to be about ten or fifteen per cent. The present determination is for the loss of light in the region λ 4500, due to the combined objective and correcting lens.

The Mills spectrograph, mounted upon the large telescope, was directed toward the region of sky 87° North Declination (S. P.) and zero hour-angle, and a spectrogram taken with a slit-width .005 inch and one hundred seconds exposure. The spectrograph, removed from the telescope, was pointed to the same region and with the above slit-width exposures were given ranging from thirty to sixty seconds. A little consideration will show (since the angular aperture of the collimator is equal to that of the 36-inch objective), that the exposure when the spectrograph is off the telescope, which gives the same image density as one hundred seconds exposure when it is on the telescope, represents the percentage of light transmitted by the objective and correcting lens.

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[*] *Publications of the Lick Observatory*, Vol. III.

[†] *Astrophysical Journal*, Vol. V, 1897.

To eliminate any error due to variation in the intensity of the sky-light with changing hour-angle of the Sun, the exposures were made in this way: One on telescope, three off telescope; one on telescope, three off telescope; one on telescope.

The effect of diffraction at the slit is to allow light outside the cone of aperture equal to that of the objective to fall upon the collimator-lens when the spectrograph is off the telescope. Any error due to this was shown, by another series of experiments in which a slit of .0006 inch was used, to be very small. In the present experiments the effect of diffraction at the slit is negligible, as a relatively wide slit was employed.

It was possible to detect a two per cent variation in the intensity of the photographic images. From the mean of ten plates an exposure of fifty-one seconds with the spectrograph off the telescope was found to give the same image density as one-hundred-seconds exposure with spectrograph on the telescope. The loss by absorption and reflection of rays λ 4500 at the 36-inch objective and correcting-lens is then forty-nine per cent. Assuming the loss at the correcting-lens to be about ten per cent, this value agrees very well with that calculated above for the 36-inch lens.

Lick Observatory.

THE LOSS OF LIGHT BY DIFFRACTION AT A NARROW SLIT.

By J. H. Moore.

In the design of astronomical slit-spectrographs, where the source of light is in general faint, the question of utilizing as much of the light as possible becomes of fundamental importance. The particular problem for which the instrument is intended will require a certain resolving power and dispersion, which in a prism-spectrograph will correspond to a definite and unavoidable loss of light by absorption and reflection at the prisms and lenses.

To obtain the required purity of spectrum it is necessary